DOCUMENT RESUME

ED 222 328 SE 039 183

AUTHOR Stevens, Phyllis W.
TITLE Computer Programs to Reduce Math Anxiety.
PUB DATE May 82
NOTE 10p.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *College Mathematics; *Computer Programs; Computers; Educational Research; Educational Technology; Higher Education; *Mathematics Anxiety; Mathematics Instruction; Psychology; *Statistics; *Undergraduate Study
IDENTIFIERS *Mathematics Education Research

ABSTRACT

Twenty-four computer programs were developed to supplement a course in statistics required of psychology majors. Thirteen are tutorial in nature. The rest provide the user with sample measures and demonstrate solution of a statistical problem (e.g., finding the product-moment correlation). Part of a CAUSE project to increase science literacy and reduce mathematics anxiety, the programs' effectiveness were evaluated in an elaborate testing program. Results showed that, as in the case of other science programs developed, using the statistics programs was not followed by a decrease in anxiety, hostility, or depression. An increase in those variables correlated very highly with increased proficiency in statistics. It was concluded that the supplemental programs enhanced students' coping skills which enabled them to turn negative emotions into constructive motivation. (Author)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED222328

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
✓ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

COMPUTER PROGRAMS TO REDUCE MATH ANXIETY??

Phyllis W. Stevens

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Phyllis W. Stevens
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

SE039183

Computer Programs to Reduce Math Anxiety??

by Phyllis Stevens

Sweet Briar College

The computer-assisted instructional programs which I shall describe were developed as part of a project funded by the Comprehensive Assistance to Undergraduate Science Education (CAUSE) of the National Science Foundation. Five science departments of Sweet Briar College participated in this project, which was intended to develop programs that would improve science literacy and reduce math anxiety. Part of the project was an evaluation which in part took the form of the administration of four standardized tests under the overall administration of an outside evaluator, the late Prof. Donald H. Thompson of Mary Baldwin College, and proficiency tests devised by the program developers. After I have described the interactive computer programs, I shall give some of the results of the evaluation.

The Programs

The 24 computer programs developed to supplement a course in statistics required of our psychology majors were written in BASIC Plus 2 for a DEC 2040 main-frame computer. The terminals that students use to interact with the computer are DEC-Writers operating at 300 BAUD. Students are given a lesson in simple terminal operation, which includes logging in, entering responses, correcting mistakes, getting out of a program, and logging off. As soon as the student has logged in, she is given the option of a menu - a list of numbered programs by name. To start a program she enters its number, and the program begins. Each student is assigned a one- or two-digit number; and when she stops running a tutorial program, she is asked to enter it for identification purposes. The computer keeps a file of her correct, incorrect and non-answers

and also the number of times she has run the program.

The programs are of two kinds, one being designed to give each student her individual sample from a population of values: Sweet Briar College Board Scores. (Her identification number is used in getting her sample, thus insuring that her sample is unique) and then to show her step-by-step how she should have solved an assigned statistical problem. By comparing their samples, statistics students can appreciate fluctuations of these from sample to sample drawn from the same population. A bonus to the instructor is ease of grading statistics class problems by using these programs. Included among them are programs to give the student her sample and making a frequency distribution based on the student's class intervals; other programs find such statistics as the mean, median, semi-interquantile range, standard deviation, and scale values and z-scores for deciles, all from the student-originated frequency distribution. Finally, a program presents a scatter-plot of paired data for a product-moment correlation based on the student's own class-intervals for X- and Y- scores, and it gives the step-by-step calculation of r from coded scales. The second type of program focuses on testing the student's understanding of concepts and the appropriate use of various statistics, and it tutors the student when she displays a lack of understanding. A list and a brief description of these programs are available in a hand-out sheet. Some of the guidelines for creating these programs follow:

1. The fewer the lines of text between questions the better is the program tutorially. Allow no more than fifteen and that many only rarely.

2. When graphics are possible - as presenting a normal curve based on standard-deviation units - build them into the program.

3. Avoid multiple-choice questions. With perhaps one or two exceptions, most questions require the student to give a free response.

Wrong answers due to typographical errors or unusual ways of stating an answer are minimized by allowing alternative spellings or abbreviations and by monitoring only the first three or four letters of a crucial word.

4. Give the student a chance to skip over already practiced or mastered material, and make it easy for her to leave a program at any time, but not without leaving her identification in a computer file.

5. When a program requires arithmetic calculations, warn the student at the beginning so that she may arm herself with paper and pencil and a pocket calculator. Calculations should not take longer than a minute or two for a knowledgeable student.

6. If statistical tables are required, notify the student at the beginning of the program, which should tell her exactly where in the computer terminal room she can find the tables she should use. This is important for us because the algorithms generating our tables produce slight errors so that the match between the computer's correct answer and that in tables in a statistics text is not always perfect.

7. Very important is varying the values of programs randomly within reasonable parameters so that students will benefit from running programs several times.

8. Even when the student has answered correctly and is praised, give the rationale for the answer; (s)he could have been lucky.

Evaluation

All classes in all science departments participating in the CAUSE project during its first year were administered four standardized tests during the first and last weeks of the term. These were the Comrey Personality Scale, the Oliver Educational Interest Inventory, the Multiple Affect Adjective Check List, Today Form (oriented toward mathematics by the directions) and a Mathematics

Opinionaire based on the Levine Math Opinionaire Scale. The average results of the scales from the first administration are typical for American women college students. The partial correlations of personality and educational interest scales with mood and attitude scores revealed such small effects from personality and interest variables that those two tests were dropped from the evaluation procedure.

During the remaining two years the Affective Adjective Check List, which provides three measures of mood (anxiety, hostility and depression) with respect to mathematics and the Math Opinionaire test, which provides measures of positive and negative attitudes towards mathematics, continued to be given during the first and last weeks.

To the consternation of all of us, anxiety, hostility and depression tended to rise during a term, regardless of discipline or instructor. Proficiency seemed to be related either to mood concerning mathematics (rising as anxiety, hostility or depression increased) or to a positive or negative attitude towards mathematics. Rarely was it related to both mood and attitude. In the case of the psychology statistics course the highest correlation between improved positive thinking about mathematics and improved performance was .14, the highest such relationship found in any discipline, and between a drop in negative attitude and improved performance, .61. However, in the same statistics course with a different instructor and different students the correlation between proficiency and decline in negative thinking was .91 but only .03 between performance and increase in positive thinking.

Correlations between number of runs of CAI programs and change of mood for one psychology class showed some rather high correlations - mostly in the non-predicted direction. Increased anxiety, hostility and depression for some of the programs correlated positively with successfulness. In other groups of

programs, a drop in negative attitude correlated with best results. For complete results see Table I, which unfortunately is based on an N of 6.

What emerges from all the data, from all the disciplines not completely described here, is the importance of feelings and attitudes as motivating forces in overcoming internal obstacles to learning science and mathematics. Anxiety may increase in students during their struggle to solve problems or before an examination as it does in actors before their appearance on stage. In the case of most of our students the anxiety and hostility did not rise to a disruptive level, as their improved science and math proficiency attests. When confronted informally by the results of the analysis presented above, several students smiled knowingly and responded with the equivalent of, "You get so anxious and mad from the frustration you are bound and determined to master the math." Perhaps for some students mastery was followed by a more positive and/or less negative attitude towards mathematics. The fact that the relationship between incresed positive thinking and improved performance was very high among statistics students in spite of the significant increase in anxiety, depression, and hostility scores indicates that negative feelings and a positive attitude may be quite independent (as in the case of an actress struck by stage fright). Although there is no direct evidence for such a conclusion, the indirect evidence that physics and psychology students reported very favorably in an interview and by questionnaire about the programs developed in the CAUSE project suggests that by helping students master difficult problems, these programs helped them cope with the frustration and negative feelings and attitudes they brought with them or developed during the course.

It may be less desirable to eliminate math anxiety, which for some students serves as motivation towards mastery, than to develop techniques that will help students tolerate the frustration from attempting to solve difficult problems.

Table I Correlations between Best Results of Runs of CAI Programs and Change of Mood for Psychology Statistics of 1980*

	Anxiety	Depression	Hostility	Negative	Positive
1 (SPMS)	0.0405	.123	0.34	-0.189	0.01
2 (ACP_1P_2)	0.78	0.86	0.86	-0.072	-0.54
3 (CCE)	0.85	0.86	0.82	0.28	-0.69
4 (CHI)	-0.37	-0.24	-0.23	-0.98	0.69
5 (TOT)	0.49	0.63	0.68	-0.18	-0.28

*Results from several programs covering somewhat related topics were combined in the following way. The programs are named.

SPMS = scales, per, mid, stand

ACP1P2 = area, corr, prob1, prob2

CCE = confidence, compare, error

CHI = chi-square

TOT = total of all programs

It may be more important to create techniques that will help them even more effectively turn their negative feelings into motives for constructive work. Inventing teaching aids that will help students to intellectual mastery of a discipline, mastery which will bring a more positive attitude towards that discipline may be more desirable than trying directly to eliminate negative feelings.

Tutorial Programs

SCALES addresses the student about the characteristics and appropriate use of three kinds of scales; ordinal, interval and ratio. It also gives her/him practice in significant digits, in exact limits of measurement and rounding off.

PER presents the student with problems concerning the appropriate use of percentages, proportions, and ratios.

MID presents randomly varied histograms which may be normal, skewed positively or negatively or may be bi-model, with randomly varied frequencies. The type of distribution is also presented in random sequence. The student is asked to give the appropriate average; mean, median, or mode.

STAND queries the student on concepts pertaining to the standard deviation and its use.

AREA gives the student practice in using a table of the normal curve to find percentages of scores between randomly varied z-scores or to find z-scores dividing randomly varied percentages of total frequencies.

CORR reviews, if the user wishes, and queries her on the appropriate use of several correlations: product-moment, rank-difference, bi-serial, point-biserial, and tetrachoric.

PROB1 and PROB2 explore with the help of problems the student's understanding of the additive and multiplicative rules for two independent events. These programs were written by Professor John Daughtry of the Department of Mathematics.

CONFIDENCE queries the student about confidence intervals, confidence limits and confidence levels in relation to the null and experimental hypotheses and introduces the student to the z-test for two large samples.

COMPARE presents student's t-test, first with samples of two-tail tests of sample means and then with the one-tail test.

ERRORS test the student's understanding of the Type I and Type II errors and their relation to alpha and beta.

CHI examines the student's knowledge of the use of chi-square and provides an opportunity for her/him to work three problems of different kinds, the frequencies of which vary randomly from one presentation to another.

AOV examines the student on concepts which form the basis for simple analysis of variance and gives the user the opportunity to work a simple analysis of variance problem with measurements and means displayed.

AOV2 takes the user through an examination and explication of two-way analysis of variance, with special emphasis on interaction. (S)he has the option of working a problem of this type.